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# Treatment modalities for Anterior Open Bite: a Systematic Review

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# Treatment modalities for Anterior Open Bite: a Systematic Review

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## Abstract

Anterior open bite (AOB) is a very common malocclusion in the orthodontic practice. The management of this malocclusion is not easy because of its multifactorial etiology; indeed, there are many factors which determines its etiology: oral habits, altered labial postures, tongue habits and a vertical facial growth pattern. The aim of this study was to analyze clinical features and the different treatments associated to AOB. Patients with AOB show the main clinical and cephalometric features: increase of anterior facial height, with a dolichofacial morphology; supra eruption of the posterior teeth or infra eruption of the anterior teeth; low position of the tongue on the floor of the mouth; increase of plane occlusal, mandibular and gonial angle; counterclockwise rotation of the mandible. The treatment of AOB is complex and it should be carried out in mixed dentition, to avoid resorting to surgery when the patient will be adult. The first therapeutic option consists in the removal of the habit with behavior-modification technique; if necessary, can be used a removable functional appliance with a vertical crib or tongue spurs. However, if the open bite is a result of a skeletal discrepancy, such as supraeruption of the posterior teeth or infraeruption of the anterior teeth, spontaneous correction might not occur. In this case, it is necessary to redirect maxillary growth with molar intrusion, to rotate the mandible in an upward and forward direction. The literature confirms that there are several ways to obtain these results.

## Introduction

Anterior open bite (AOB) is a malocclusion defined as the absence of contact between the incisal edges of the maxillary and mandibular teeth. It is considered one of the most difficult orthodontic problems to correct because of the multifactorial etiology that is the result of the interaction of numerous etiological factors, which includes oral habits such as mouth breathing, altered labial postures, tongue habits, and vertical facial growth pattern<sup>1-12</sup>.

Several authors have given a definition to AOB<sup>13-14</sup>;

Subtelny and Sakuda<sup>15</sup> evaluated anterior open bite as a deviation in the vertical relationship of the maxillary and mandibular dental arches with a definite lack of contact in the vertical direction between opposing segments of teeth.

AOB can be manifested as a dentoalveolar or skeletal open bite (or both). Anterior open bite is one of the most difficult malocclusion to be treated in the permanent dentition, because dentoalveolar open bite can evolve during growth in skeletal open bite.

Development of a skeletal open bite has been attributed to lack of coordination between horizontal factors (condylar-glenoid fossa growth) and vertical factors (growth of the maxilla and the dentoalveolar processes). Increased expression of vertical factors rather than horizontal factors results in clockwise rotation of the mandible, with the appearance of a skeletal anterior open bite<sup>16,17</sup>. The disorder could also be caused by a long habit of sucking finger, causing the conversion of a dental open bite into a skeletal open bite. Indeed, in presence of a specific risk factors, for example, a prolonged sucking habit, facial skeletal characteristics can worsen the entity of the malocclusion. The prevalence varies from 1,5% to 11%<sup>14</sup>, with a high prevalence in the mixed dentition; in caucasian population, the prevalence has been found to be 2.9%<sup>1</sup>.

Anterior open bite is often associated with posterior crossbite, another malocclusion that develops in childhood, because they have common risk factors<sup>19,20</sup>, such as non-nutritive sucking habits. Origins of open bites are especially important in growing subjects, because when non-nutritive sucking habits are no longer present, the malocclusion is self-correcting. Indeed, the primary dentition directly influences the development of permanent occlusion; a lot of anomalies present in the deciduous dentition remain in permanent dentition; for this reason, oral habits should be eliminated before eruption of upper permanent incisors. The aim of this study was to analyze occlusal and dentoalveolar features and the different treatments associated to AOB.

## Materials and Methods

In the recent years, several orthodontic works have

been published on international literature about the incidence of different forms of anterior open bite and, in particular, on its treatment planning. So a detached research of international literature on the diagnosis and all the possible treatment methods for this malocclusion has been performed using the principal medical databases: PubMed (Medline), Lilacs and Scopus. The keywords used were: *anterior open bite*, *posterior discrepancy*, *skeletal discrepancy* and *Class II Malocclusion*; to identify all articles reporting on the topic until October 2016. No restrictions of time and languages have been fixed. The results have been filtered and valued following our eligibility criteria and then organized following the PRISMA method. The search identified 10,320 abstracts, which were reviewed manually and each article of interest was marked for further review. The full text of the marked studies was retrieved and studies that satisfied our eligibility criteria were included in this review. At the end only 64 full articles have been selected.

## Review

### Clinical and radiographic features

Patients with AOB generally present:

- Increase of anterior facial height and mandibular
- Long-facial morphology (dolichofacial)
- Increase of maxillary molar dentoalveolar height
- Supra eruption of the posterior teeth or infra eruption of the anterior teeth <sup>15,21-26</sup>
- Mesial inclination of posterior teeth <sup>15,21-26</sup>
- Lack of a normal Spee curve <sup>15,21-26</sup>
- Low position of the tongue on the floor of the mouth
- Cross bite due to the absence of the lingual pressure
- Supra eruption of the posterior teeth or infra eruption of the anterior teeth
- Difficulty in biting with the incisor teeth <sup>13-15,27,28</sup>
- Lingual interposition during swallowing <sup>13-15,27,28</sup>

The cephalometric values that characterize patients with open bite are:

- Increase of plane occlusal, mandibular and gonial angle <sup>21,29</sup>
- Divergent planes <sup>21,29</sup>
- Counterclockwise rotation of the mandible
- Decrease of ramus and mandibular body
- Decrease in the interincisal angle
- Recessive chin
- Reduced inter-incisal angle
- Reduced inter-molar angle

Several studies showed a decrease in posterior facial height in patients with anterior open bite. Nahoum <sup>30</sup> and Cangialosi <sup>31</sup> found that the ratio of upper facial

height to total facial height was smaller for subjects with anterior open bite, and that this ratio seemed remains constant during growth.

### Treatment

Open bite malocclusion has been considered a difficult problem to treat because its etiology is multifactorial. The indications to treatment are aesthetic and functional. Patients with a severe AOB could have difficulty affecting food and speech problems <sup>27,28</sup>. The resolution of open bite usually helps with eating, but it could not solve the language difficulties. The ideal time to start the orthodontic treatment is during the mixed dentition; in fact, the use of orthodontic appliances to correct an open bite in the deciduous dentition is not indicated, because of continuing growth changes. However, the treatment must be carried out during the patient's growth to avoid surgery. In the mixed dentition to correct the open bite associated with abnormal habits it must be eliminated the habits with behavior-modification techniques, associating speech therapy; if necessary, a removable functional appliance with a vertical crib can be used. In about half of the patients, the habit ceases prematurely and the anterior open bite closes spontaneously. In fact, self correction of dental AOB occurs in 80% of patients when the habit is eliminated up until the phase of mixed dentition <sup>32</sup>. The vertical crib represents an obstacle in nonnutritive sucking and maintains the tongue in a retruded position, preventing the interposition between the upper and lower incisors. The appliance helps remove etiologic factors and provides a stable correction of the anterior open bite. The spurs are an effective option to allow normal development of the anterior dentoalveolar region, since they prevent thumb sucking, tongue thrusting, and anterior tongue rest posture <sup>33,34</sup>. The effects of this device include palatal tipping of the maxillary incisors, increases in overbite and in dentoalveolar development of the maxillary and mandibular incisors. Justus <sup>34</sup> demonstrated that AOB can be solved using tongue spurs to a maxillary lingual arch; the result seems to remain stable because of the development of a new muscle engram. A review showed that anterior tongue rest posture is a primary contributing factor to AOB; so, the use of tongue spurs to change the tongue posture, it is able to correct AOB, with long-term results. After the habit is eliminated, it's important to maintain the appliance for 3 to 6 months to prevent the recurrence. However, if the open bite is the result of skeletal discrepancy, such as an increase of anterior facial height and mandibular, supra eruption of the posterior teeth or infra eruption of the anterior teeth, spontaneous correction might not occur. In this

case it is necessary to redirect maxillary growth with molar intrusion<sup>35</sup>, to rotate the mandible in an upward and forward direction. If the molars are intruded, the mandible may appear to translate forward, with the same effects obtained with the use of functional appliances. The literature confirms that there are several ways to correct AOB, depending on diagnoses.

A traditional method consists in the inhibition of vertical maxillary growth or intrusion maxillary molars with headgear<sup>25,36,37</sup>. This appliance results in the intrusion of extruded molars, which are the cause of anterior open bite. It is a practical device because it can be used in association with other functional and fixed appliances.

Posterior bite blocks are usually used in the early treatment of AOB<sup>10,38-43</sup>; they are also an effective option for intruding and controlling the eruption of posterior teeth. This is a non-invasive technique which does not require the patients' cooperation since the resin blocks are cemented on the posterior teeth. This appliance allows the counterclockwise rotation of the mandible and an improvement of vertical anterior relation.

Functional devices used in combination with high-pull headgear can be used in growing patients, where the AOB is associated with a class II malocclusion<sup>10</sup>. This combination of devices allows to solve the sagittal discrepancy checking the vertical dimension. The mostly used device is the twin block, that possesses two bite blocks, one upper and one lower, that stimulate mandible to assume a forward position. An others functional devices that can be used in cases of anterior open bite are the open-bite bionator and the Fränkel 4. Open-bite bionator is a removable functional device comprising posterior bite blocks with the function to intrude the posterior teeth<sup>44</sup>. The device incorporates an acrylic lingual portion that extends from the bottom in the upper region as lingual shield; the vestibular arc is set at the height of the correct closing latches. Fränkel 4 is supported in cases where AOB occurs in part because of the deficit of postural activity of the oro-facial musculature<sup>45</sup>. Recently, it was realized a new device for rapid molar intrusion (RMI appliance)<sup>46,47</sup>. The device is able to perform, at the same time, an intrusive force on the maxillary and mandibular molars, whereas it doesn't require surgery or patient cooperation. The appliance is composed of elastic modules that are attached to orthodontic bands placed at the level of the maxillary and mandibular first molars. Inside the tubes of the bands, there are the terminal ends of each module positioned with I-shaped pins. When the patient closes your mouth, the elastic modules flex and produce an

intrusive force of 600–900 g on each side. The device seems to produce more intrusion of the maxillary molars compared with the mandibular molars. After about five months, the modules of the RMI are removed and it was completed the fixed therapy. The appliance is comfortable, it allows good oral hygiene and It doesn't interfere with chewing and with aesthetics, because it is positioned in the molar area. The only adverse movement obtained is buccal crown tipping due to the applied force that is lateral to the molars' center of resistance. The control of intrusion movement is obtained by the use of an upper palatal arch and a lingual arch in the lower jaw. The device can be applied in the mixed dentition or in the permanent dentition along with full fixed brackets. In the presence of an AOB, a tongue crib or another device, may be incorporated into transpalatal arch. The disadvantage of this device is that it can not be used in patients with a skeletal class III because of the advancement of the chin and the anterior rotation of the mandible that occurs as a consequence of the RMI effect. The results obtained show that the device is able to solve the problem of AOB without resorting to surgery. The multiloop edgewise archwire (MEAW) is another therapeutic option; MEAW<sup>48,49</sup> was introduced by Kim<sup>25</sup> for anterior open bite closure treatment. This technique has been applied for treatment of severe open-bite malocclusions. The objectives of treatment include uprighting of molars and extruding of anterior teeth. Heavy intermaxillary elastics are used to close the anterior open bite by extruding the anterior segments. The form of the MEAW is a 16x22 ideal archwire in an edgewise bracket system, without prescription for torque, angulation or tip, with the addition of vertical and horizontal loops.<sup>3</sup> The vertical loop component gives flexibility to the archwire, and allows horizontal control of the tooth positions.<sup>9</sup> The horizontal component gives more flexibility and provides vertical control of the tooth. The loops are five in each quadrant and are positioned distal to the lateral incisors between two brackets. MEAW is also 2,5 times longer than the normal archwires. MEAW therapy has been demonstrated to be effective for the treatment of anterior open bites. The disadvantages of this technique are the dependence on patient compliance and the risk that the correction occurs by the extrusion of the anterior teeth, not by the intrusion of molars<sup>50</sup>.

Definitive treatment of skeletal open bite generally requires the combination of orthodontic treatment and orthognathic surgery. Surgical approach consists in performing a LeFort I osteotomy and, in some cases, mandibular ramus osteotomy, which repositions the maxilla allowing the counterclockwise rotation of the

mandible<sup>51</sup>. Orthognathic surgery for the anterior open bite malocclusion seems to be unstable. Various studies have compared different orthognathic treatments to close an AOB. For example, Proffit et al. found that maxillary impaction was less prone to relapse than two jaw surgery (7% overbite decrease against the 12 % overbite decrease)<sup>52</sup>. One of the factors that determines the vertical postsurgical relapse seems to be the osteotomy fixation technique. Further negative consequences of surgery are: postoperative pain, swelling, edema, bruising, altered nerve sensation, dangers of general anesthesia, costs, and rehabilitation after surgery. Therefore, the risks and the price of surgical treatment have initiated a search for alternative procedures. In recent years, as alternative to treat the skeletal AOB by orthognathic surgery, it was introduced a new modality of open bite treatment, through the use of titanium miniplates and miniscrews, to intrude the posterior teeth<sup>50,53-60</sup>. The positive aspect is that the use of skeletal anchorage can avoid the need for orthognathic surgery in the patients with AOB. Microscrew implants are so small to be positioned in any area of the alveolar bone, easy to insert and remove and, not to underestimate, inexpensive. TADs (temporary anchorage devices) provides the maximum desired anchorage. So, orthodontic treatment with TADs, seems to improve facial esthetics without increasing the anterior facial height. Furthermore, skeletal anchorage eliminates the need for patient compliance. Several studies report excellent results for open bite treatment with maxillary molar intrusion. The studies of Umemori et al<sup>61</sup> demonstrated the effectiveness of the intrusion of mandibular molars by using titanium miniplates for anchorage, without the undesirable side effects of extrusion of anterior teeth. In this cases, they have been used two titanium L-shaped miniplates at the level of the buccal cortical bone around the apical regions of the lower first and second molars. Through the use of intraoral elastics, the lower molars were intruded and open bite was closed. A month later, it was added the fixed appliance in both dental arches. Despite the intrusion had been completed after five months, the fixed appliance and the miniplates were removed after eighteen months. Since Umemori et al described the use of miniscrews in the treatment of open bite, several authors have suggested that skeletal open bite can be corrected using TADs. All these cases reported the intrusion of the molars in both arches with TADs, with the consequent counterclockwise rotation of the mandible and increased overbite.

## Conclusions

Due to the different clinical and cephalometric features, and a targeted medical history, it is possible to make an early diagnosis of AOB. This is very important to avoid more invasive procedures after the patient's growth. Currently, however, many alternatives to surgery are available, such as to allow a complete resolution of the malocclusion.

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